Biochar for the long-term stabilization of metals in low to moderately contaminated soils

Caleb Elijah Egene[1]; Reinhart Van Poucke[1]; Yong Sik Ok[2]; Erik Meers[1]; Filip Tack[1]*

[1] Department of Green Chemistry and Technology, Ghent University, Coupure Links 653, Ghent, Belgium

[2] O-Jeong Eco-Resilience Institute (OJERI) & Division of Environmental Science and Ecological Engineering, Korea University, Seoul 02841, Republic of Korea.

* Corresponding author. E-mail: filip.tack@ugent.be

Soil degradation due to metal contamination is a major environmental concerns threatening the sustainability of agricultural production. The use of biochar has emerged as a potentially viable and affordable strategy for the long-term stabilization of metal concentrations in such soils. The potential of holm-oak derived biochar to immobilize Cd in a diffusely contaminated soil in the Campine region of Belgium was investigated. Incubation experiments were prepared with the soil-biochar mixture and Cd concentration was monitored by means of rhizon soil moisture samplers (SMS) over a period of three years. Over the three years of incubation, concentrations in the soil solution tended to continue to decrease, although to a limited extent. Biochar strongly reduced the concentration of soluble Cd from 120 µg/l at the start of the experiment to 10 µg/l. The mechanisms responsible for observation were suggested to be the formation of metal precipitates due to increase in pH and the sorption of DOC onto the surface of biochar which increases its negatively charged functional groups that are able to sorb cations. For comparison, addition of compost or peat to the contaminated soil led to a significant increase in the soluble Cd concentration. This was likely due to a negative or a complete absence of a pH effect from the addition of the amendments. Furthermore, the high concentrations of DOC in the compost and peat treatments may have caused the formation of soluble organo-metallic complexes. The results from this study highlight advantages of biochar over other organic amendments for metal immobilization in soils. However, there are still unanswered questions about the long-term stability of biochar's metal immobilization effect. For example, what are the impacts of changing soil physico-chemical conditions on metal mobility? Further studies are required to explore the interaction mechanisms among biochar, soil and metals over more extended periods of time.

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